

SECTION 3000 - SANITARY SEWERS

3001 SCOPE. This section applies to sanitary sewer construction and shall consist of furnishing all labor, materials, and equipment for the complete installation of sewers and appurtenances.

3002 GENERAL. It is understood that throughout this section these specifications may be modified or deleted by appropriate items in the contract documents.

When reference is made to a standard specification (ASTM, AWWA, etc.), the specification referred to shall be understood to mean the latest revision of said specification except as otherwise noted in the contract documents.

3003 MATERIALS.

A. Reinforced Concrete Pipe

Pipe	ASTM C76, except as modified herein.
Fine Aggregate	Clean natural sand, ASTM C33. Artificial or manufactured sand will not be permitted.
Cement	ASTM C150, containing not more than five percent (5%) tricalcium aluminate.
Gaskets	ASTM 361 polymer shall be neoprene or other synthetic rubber. Natural rubber will not be acceptable.

B. Ductile Iron Pipe

Pipe	ANSI A21.51; ASTM A536, Grade 60-42-10, Thickness Class 50 unless otherwise required by the City Engineer.
Mechanical and Push-On Joint	ANSI 21.11, except gaskets shall be neoprene or synthetic rubber. Natural rubber will not be acceptable.
Flanged Joints	ANSI A21.10.
Fittings	ANSI A21.10, pressure rating of not less than that specified for pipe.

Lining & Coating Lining application shall be performed by pipe manufacturer only. Jobbing of lining will not be allowed. All lining shall be done at point of pipe manufacture.

1. Polyethylene Lining:

All pipe and fittings shall be lined with virgin polyethylene complying with ASTM D1248, compounded with an inert filler and with sufficient carbon black to resist ultra-violet degradation during aboveground storage of the pipe and fittings. The polyethylene lining shall be bonded to the interior of the pipe or fitting by heat.

Polyethylene linings for pipe and fittings shall have a nominal thickness of 40 mils. Minimum lining thickness shall be 30 mils. Linings shall cover the interior surface of pipe and fittings in conformance with the following:

The lining for pipe utilizing push-on gaskets shall extend from the spigot and through the socket to the edge of the gasket sealing area. The lining for pipe utilizing mechanical joints shall extend from the spigot and through the socket to the edge of the gaging ring. The lining in fittings shall cover the interior surfaces including the socket areas as defined above.

2. Calcium Aluminate Lining:

Before lining the pipe with cementitious material, a portion of the gasket cavity and a portion of the pipe barrel shall be coated with a minimum of 8 mils of Tnemec Series 61-D1182 black epoxy. The bell end portion to be epoxy coated starts with the gasket seating area, continues through the bell shoulder, and concludes with the first 4 inches of the pipe barrel interior. The spigot end shall be epoxy coated on the interior and exterior surfaces.

The lining shall be a pure fused calcium aluminate mortar comprised of fused calcium aluminate cement combined with fused calcium aluminate aggregates. A seal coat shall be applied to the lining.

The thickness of the lining shall be a minimum of 0.125 inches (125 mils) for 6" through 12" pipe, 0.187 inches (187 mils) for 14" through 24" pipe. The lining thickness may taper to less than the specified minimum at the ends of the pipe.

Field-cut end repairs are to be done in accordance with the pipe manufacturer's recommendations. End repairs are limited to exposed metal within the pipe joint. The calcium aluminate cement lining does not require sealing or protection.

Cracks, other than closed hairline cracks and/or fine crazing, shall not be acceptable. Loose areas of cement are not allowable. Visual inspection of the lining is sufficient.

C. Polyvinyl Chloride (PVC) Pipe

Pipe*	Pipe shall be seamless. Pipe material shall conform to ASTM D 1784 and shall have a minimum cell classification of 12454B, 12454C, 12364A, or 13364B. Pipe sizes 18" and less shall conform to ASTM D-3034 or ASTM F-789. Pipes larger than 18" shall conform to ASTM F-679 or F-794. Minimum pipe stiffness for pipe used for stublines and for pipes with depths to invert up to 15 feet shall be SDR 35. SDR 26 shall be used for pipes with depths to invert greater than 15 feet.
Joints	All gasketed joints shall be compression, bell and spigot push-on conforming to ASTM D 3212-89 "Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals", conforming to ASTM F 477. Lubricant shall be as recommended by the pipe manufacturer.
Fittings	Fittings defined as tee connections suitable for assembly to 6-inch house or building sewers shall be saddle-type fittings molded of PVC materials conforming to ASTM D 1784. All fittings shall utilize Elastomeric seals and shall be suitable for use with the respective ASTM PVC pipe standard or molded PVC. Insert-a-tee is acceptable for service connections on 12" and larger service mains.

*When PVC is used on force mains, a tracer wire shall be installed allowing accurate locates of the main.

- 3004 ALIGNMENT. Piping shall be laid to the lines and grades indicated on the drawings using laser beam equipment, surveying instruments or batter boards to maintain alignment and grade. If batter boards are used, they shall be erected at intervals not exceeding 25 feet. Not less than three batter boards shall be maintained in proper position at all times during the trench grading operation.
- 3005 HANDLING. Pipe, fittings, and appurtenances shall be transported, unloaded, stockpiled, distributed, and installed or otherwise handled in a manner which prevents damage thereto and

which will ensure the delivery and installation thereof in a sound and acceptable condition. Hooks shall not be permitted to contact joint surfaces. Damaged pipe shall be removed from the site.

- 3006 CLEANING. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted. All joint contact surfaces shall be kept clean until the joint is completed.

Whenever pipe laying is stopped, the open end of the pipe must be closed by using a pipe plug to prevent trench water, sand, and earth from entering the pipe. In no case shall said plug be removed and water allowed to enter the sewer until the Engineer is satisfied that the sewer will not be injured by water coming in contact with the pipe, pipe backfill or subgrade. The Engineer may require the contractor to pump the water from the trench before continuing trenching or pipe laying operations.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing, or other materials shall be placed in the pipe.

- 3007 LAYING PIPE. Lateral displacement of the pipe shall be prevented during embedment operations. Pipe shall not be laid in water, nor under unsuitable weather or trench conditions.

Pipe laying shall begin at the lowest elevation with bell ends facing the direction of laying except when reverse laying is permitted by the Engineer.

- 3008 JOINTING. All joint preparation and jointing operations shall comply with the instructions and recommendations of the pipe manufacturer. Immediately before joints are pushed together, all joint surfaces shall be coated with the lubricant furnished with the pipe. The position and condition of each rubber gasket (unbonded gaskets) shall be checked with a feeler after the joint is completed.

Joints for reinforced concrete pipe shall conform to Section 7 of ASTM C361 except that gaskets shall have a circular cross section and shall be confined in a groove in the pipe spigot. Pipe with collars in lieu of integral bells will not be acceptable.

Joints for PVC pipe shall comply with all recommendations and instructions of the pipe manufacturer.

- 3009 TEMPORARY PLUGS. Provide and install plugs as manufactured by pipe supplier or as fabricated by contractor of approved construction. Plugs shall be watertight against heads up to 20 feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

Mechanical plugs, braced with a 4x4 timber wedged against the opposite wall of the manhole, shall be installed at the downstream end (connection with existing line) on all sanitary sewer extension projects under construction and shall be verified by the contractor at the completion

of each working day. Also, the open end of the sewer shall be plugged at the end of the work day with a suitable mechanical plug to prevent entry of foreign material until work is resumed.

- 3010 CONNECTIONS TO EXISTING PIPELINES AND STRUCTURES. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.

Prepare structure by making an opening with at least two inches (2") clearance all around fitting to be inserted. The concrete structure shall be initially cut with a concrete saw in conformance with the method and tolerances shown on city standard drawings. Opening between pipe and manhole wall shall be filled with an expansive grout in such a manner that a watertight condition will result.

Manholes to be built on an existing sewer shall be constructed in such a manner as will not disrupt service of the existing sewer. The manhole base, walls, and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the contractor shall be repaired or replaced at no expense to the city.

Connections between different pipe materials shall be made using proprietary transition coupling, unless otherwise specified on the drawings.

- 3011 TEE BRANCHES AND SADDLES. Tee branches and saddles shall be pitched at 45° and installed at locations designated on the plans. The contractor shall verify that tee branch or saddle locations have been marked in advance of the construction of sewers serving any property which will require sewer service and, if the locations have not been designated, shall stop the sewer construction until the necessary tee branch or saddle locations have been obtained.

Tee branches and saddles shall be installed with the lower lip not more than two inches (2") below the outside top of the pipe. Tee branches or saddles shall not be covered until each location has been recorded.

Each tee branch or saddle shall be marked with a wooden strip extending from the tee vertically to within one foot (1') of the ground surface. **All service line branches shall be extended to within 8 feet of the minimum sewerable floor elevation at the time of the main construction.** Markers shall be securely anchored and maintained vertical until backfilling has been completed. Tee branches or saddles shall be closed with a suitable plug held in place by an approved joint sealing compound.

3012 SERVICE CONNECTIONS. Service connections made to the sewer prior to backfilling shall not be installed as vertical risers but shall be laid on a slope not to exceed one foot vertical to one foot horizontal. A 45° bend shall be used to join the tee branch to the service connection or stub line. The service pipe shall make such a horizontal angle with the sewer line that a proper connection to the 45° bend or stub line is obtained without trimming the pipe and with no danger of jute or jointing material being forced into the sewer. Each service connection pipe shall have a solid bearing on rock backfill.

3013 CONCRETE ENCASEMENT. Concrete encasement shall be installed as shown on the drawings and where, in the opinion of the Engineer, such pipe encasement is necessary because of unforeseen conditions encountered in the work. All pipe which is to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation. The minimum 28-day compressive strength of concrete used for encasement of sewer lines shall be 3000 psi.

3014 WATER LINE CLEARANCES

GRAVITY SANITARY SEWERS - When potable water pipes and gravity sanitary sewers are laid parallel to each other, the horizontal distance between them shall be not less than 10 ft (3.0 m). The distance shall be measured from edge to edge. The laying of water pipes and sanitary sewers shall be in separate trenches with undisturbed earth between them. In cases where it is not practical to maintain a 10 ft (3.0 m) separation, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer. Equivalent protection may require sanitary sewer construction with one of the following additional protective features: concrete encasement, vacuum sewers, or jointless pipe such as polyethylene or cured-in-place.

When a water pipe and a sanitary sewer cross and the sewer is 2 feet (0.6 m) or more (clear space) below the water pipe, no special requirements or limitations are provided herein. At all other crossings, the sanitary sewer is to be constructed of one of the following materials (or approved equal) and pressure tested to assure water tightness pursuant to Chapter VI of the KDHE Minimum Standards of Design of Water Pollution Control Facilities.

- Ductile iron pipe conforming to ASTM A536 or ANSI/AWWA C151/A21.51 with minimum thickness class 50, and gasketed, push-on or mechanical joints in conformance with ANSI/AWWA C110/A21.10 or ANSI/AWWA c111/A21.11.
- PVC pipe conforming to ASTM D3034 with minimum wall thickness of SDR41, ASTM F679, ASTM F789, or ASTM F794, with gasketed push-on joints in conformance with ASTM D3212.
- Reinforced concrete pipe conforming to ASTM C76 with gasketed joints in conformance with ASTM C361 or ASTM C443.

Joints in the sewer pipe shall be located as far as practical from the intersected water main.

Where a water main is laid across or through an area where there is an existing sanitary sewer, which is not constructed of one of the above specified materials and is 2 feet (2'/0.6 m) or less below the water pipe, the existing sewer shall be encased in concrete with a minimum of six inches (6"/15 cm) thickness for a 10 foot (10'/3.0 m) distance on each side of the crossing or the crossed section of sewer replaced to meet the above specified construction requirements. KDHE will consider proposals providing equivalent protection by other means on a case-by-case basis, if supported by data from the design engineer.

Where sanitary sewer lines are to be installed under and across water lines and a two foot (2') clearance cannot be obtained because of limiting grades or grades of existing structures, then the sewer line shall be constructed of ductile iron pipe for a distance of at least ten feet (10') in each direction from the crossing.

SEWER CONNECTIONS. There are to be no physical connections between any parts of the potable water system with building sewers, sanitary sewers, or wastewater treatment facilities by means of which it would be possible for sewage, even under exceptional circumstances, to reach the wells, storage reservoirs, or distribution systems.

PRESSURE SEWER LINES. When force mains run parallel to water lines, the separation distance shall be as far as practical, but at least a 10 ft (3.0 m) horizontal separation shall be maintained. There shall be at least a 2 ft (0.6 m) vertical separation at crossings with the water main crossing above the sewer force main. In cases where it is not practical to maintain the required vertical or horizontal separation distance between a water line and a sanitary sewer force main, KDHE will consider proposals providing equivalent protection by other methods on a case-by-case basis, if supported by data from the design engineer.

SEWER MANHOLES. No water pipe shall pass through or come in contact with any part of a sewer manhole.

STORM SEWERS. The separation distance between a storm sewer (which is not a combined storm/sanitary sewer) and a water main should be based on geotechnical considerations.

DRAINS. Underground drains from fire hydrants or valve pits should not be directly connected to sanitary or storm drains.

All of the above recommended protective measures shall apply to water and sewer service lines.

All special protective measures outlined by KDHE shall be required in the final design and implemented during the construction phase when it is impractical for geotechnical reasons, to cross water lines over sewer lines.

3015 **SEWER MANHOLES.** Manhole construction shall comply with all of the applicable requirements of Section 3100 *Sanitary Sewer Manholes*.

3016 ACCEPTANCE TEST. Each reach of sewer shall meet the requirements of the following acceptance tests. All defects shall be repaired to the satisfaction of the Engineer by and at the expense of the contractor.

- A. Infiltration Test. An infiltration test will be required when the sewer line is below the ground water level. The amount of water leaking into the sewer shall be measured and it shall not be more than 50 gallons per day per mile of pipe, per inch nominal diameter.
- B. Exfiltration Test. In areas where the ground water level is below the pipe, the contractor shall perform an exfiltration test. The section of sewer to be tested shall be filled with water so that the water level in the upstream manhole is at least four feet (4') above the flow line or two feet (2') above the top of the pipe, whichever is greater.

The amount of water added during the test period to maintain the water level shall be measured and it shall not exceed a rate of 50 gallons per day, per mile of pipe, per inch nominal diameter.

- C. Air Test. As an alternate to the exfiltration test, the contractor may perform a low pressure air test when approved by the Engineer. The section of pipe between successive manholes shall be sealed with suitable plugs. One of the plugs shall have a positive on-off valve and suitable means for readily disconnecting it at the control panel. A second orifice in the plug shall be used for constantly reading the internal pressure of the pipe. This orifice shall be continuously connected to a pressure gauge having a range from 9 to 10 psi. The gauge shall have minimum divisions of 0.10 psi and shall have an accuracy of ± 0.04 psi. Reinforced concrete pipe shall not be air tested.

Low pressure air testing shall be conducted on all lines unless otherwise directed by the City Engineer. The testing methods and air leakage rates shall conform to the requirements of ASTM F-1417-92 or the latest revision thereof. Each reach of sewer pipe between manholes shall be tested after completion of the installation of the pipe, appurtenances and the backfill of the sewer trench. Internal air pressure shall be monitored so that it will not exceed 9.0 psig.

Determine the rate of air loss using the time-pressure drop method. Slowly introduce air into the section of pipe to be tested, until the air pressure is raised to approximately 4.0 psig and the section of pipe section is stabilized. As discussed previously, disconnect the air supply and decrease the pressure to 3.5 psi before starting the test. Determine the time required for the pressure to drop from 3.5 psi to 2.5 psi and compare this interval to the required time to decide if the rate of air loss is within the allowable minimum times required by pipe diameter are shown in Table 1.

If the pressure drops 1.0 psi before the appropriate time shown in Table 1, the air loss rate shall be considered excessive and the test section fails. If the test section fails, leaks shall be repaired and the line shall be retested to the requirements of this test method. **“Fernco” rubber clamp-on type repair couplers will not be an acceptable method of repair.**

Solid repair sleeves shall be used on all new construction. Prior to acceptance, all constructed sewer lines shall satisfactorily pass the low pressure air test.

Upon completion of the test, open the bleeder valve and allow air to escape. Plugs should not be removed until all air pressure has been reduced.

Example of how to use Table 1:

What should the required test time be for a 1.0 psig pressure drop in 327 feet of 8-inch diameter pipe between manholes.

Solution:

The exact time is easily calculated by using Table 1. Since 327 feet exceed the 298 feet length associated with the minimum test time for an 8-inch pipeline, the fourth column in Table 1 is used to calculate the required test time as follows:

$$T = 1.520 \times L = 1.520 \times 327 = 497s$$

Therefore, the required test time for a 1.0 psig pressure drop is 497 s or 8 minutes and 17 seconds.

ASTM F 1417

TABLE 1

Minimum Specified Time Required for a 1.0 psig Pressure Drop for Size and Length of Pipe Indicated for Q = 0.0015

Note 1--See Practice UNI-B-6-90

Note 2--Consult with pipe and appurtenance manufacturer for maximum test pressure for pipe size greater than 30 in. in diameter

Pipe Diam. In	Min. Time min:s	Length for Minimum Time, ft	Time for Longer Length, s	Specification Time for Length (L) Shown, min:s							
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft
4	3:46	597	0.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	0.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

In areas where ground water is known to exist, a one-half inch diameter capped pipe nipple approximately 10 inches long is to be installed through the manhole wall on top of one of the sewer lines entering the manhole. This installation is to be done at the time the sewer line is constructed. Immediately prior to the performance of the line acceptance test, the ground water level shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground to clear it and then connecting a clear plastic tube to the pipe nipple. The tube shall then be held vertically and a measurement of height in feet of water shall be taken after the water height has stabilized in the tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure to be added to all readings.

All pressure sewage force mains shall have hydrostatic pressure and leakage tests performed prior to acceptance. No pressure sewer line shall be accepted unless passing the prescribed requirements. All tests shall conform to AWWA C600 procedures as modified herein and shall be applicable to all pressure sewers. The test shall be conducted after line installation and trench backfilling is complete.

The test shall be performed separately in segments between sectionalizing valves and a test plug, or between test plugs. Test segments shall be selected so that adjustable seated valves are isolated for individual checking. The contractor shall furnish and install test plugs at no additional cost to the owner, including all required anchors, braces and other devices to withstand hydrostatic pressure on the lugs. Any damage to public or private

property caused by failure of the plugs shall be the responsibility of the contractor. The fill rate of the line shall be limited to the available venting capacity.

The pressure test shall be conducted at 1.5 times the maximum operating pressure determined by the following formula:

$$P_{pt} = 0.650 (OP-GE), \text{ in which}$$

P_{pt} = test pressure in psi at gauge elevation

OP = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line.

GE = elevation in feet at center line of gauge.

The test shall be performed satisfactorily prior to determining leakage.

The leakage test shall be conducted at maximum operating pressure as determined by the following formula:

$$Plt = 0.433 (OP-GE), \text{ in which}$$

Plt = test pressure in psi at gauge elevation

OP and GE = as in pressure test

All joints shall be watertight and free from leaks as determined by the test.

If any of the above tests fail to meet the above prescribed requirements, the test shall be repeated as necessary after all leaks and defects have been repaired.

- E. Deflection Test. A deflection test shall be required on all installations involving flexible or semi-rigid pipe after said pipe has been laid and backfilled. The maximum allowable deflection shall not exceed 5.0 percent (5%) of the pipe's actual internal diameter as measured in the field. The deflection test shall consist of guiding a device of the appropriate size for the pipe involved to accurately measure any deflection in the pipe. The device to be used shall be approved by the City Engineer prior to its use. Attention is directed to the fact that the pipe's nominal diameter is greater than the actual internal diameter of the pipe. Lamping will not be approved as a substitution for deflection testing.

Upon completion of the testing, all piping showing a deflection greater than 5.0 percent (5%) shall be excavated, replaced, backfilled, and retested to the satisfaction of the Engineer.

- F. Video tapes. The contractor will be required to provide video tapes to the city after all testing of the sewer line is complete. The video camera shall be placed in the downstream manhole for each section and pulled to the upstream manhole. If services lines or service stubs have been installed with the project, each service must be noted as a distance in feet from the downstream manhole. The completed video tape must include monitoring of distance in feet from the downstream manhole for all sections of pipe installed. The city will complete a second video of the sewer pipe prior to the expiration of the two year maintenance bond. If any maintenance is required during the two year maintenance period, the contractor will be required to video all repaired sections of pipe to verify corrections.